Effect of Sesamex on Brain Acetylcholinesterase Inhibition by Parathion in Fishes[1]

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Reports by Henderson and Pickering (1) and Minchew (2) have shown parathion to be highly toxic to several species of fresh water fishes. The toxic action of parathion is generally considered to result from inhibition of acetylcholinesterase (AChE) by the more potent anticholinesterase, paraoxon.

The activation of parathion to paraoxon is effected by microsomal mixed function oxidases (MMFO) of the vertebrate liver. Potter and O'Brien (3) have shown that livers of several aquatic species, including fishes, are capable of performing this activation. Several compounds alter the activity of hepatic MMFO and thus affect the toxicity of organophosphorus (OP) insecticides.

In studies by Sun and Johnson (4), 1% sesamex was found to be a synergist for many OP insecticides but was found to be an antagonist to the toxicity of parathion, methyl parathion and EPN in house flies (Musca domestica L.). They concluded that this antagonism was mediated through a decreased capacity of flies to intoxicate the parent compound due to inhibition of the activating enzyme. This conclusion was substantiated by the finding that flies treated with .005% parathion suffered 90% mortality and a 20.8% inhibition of head AChE in 4 hr; treatment with the addition of 1% sesamex to the same concentration of parathion produced only 5% mortality and no inhibition of head AChE activity.

We report the effect of sesamex pretreatment on parathion activation - as reflected by brain AChE activity - in 3 species of fresh water fishes.

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Materials and Methods

Golden shiners (Notemigonus chrysoleucas), green sunfish (Lepomis cyanellus) and bluegill sunfish (Lepomis macrochirus) seined from ponds having no known insecticidal contamination were acclimated to laboratory conditions prior to testing.

Fish were exposed to 2 ppm sesamex (diluted from a 1% (v/v) solution of sesamex in acetone) for 24 hr in stainless steel aquaria (1 fish/liter of test solution). Control fishes were held in 40 liters of water containing an equivalent amount of acetone.

After the 24-hr sesamex pretreatment, 20 fishes were removed from the sesamex solution and placed in 200 ppb parathion for 10 hr. Twenty control fishes were also transferred to a 200 ppb parathion solution for 10 hr, after which time both groups were sacrificed and assayed for brain AChE activity.

AChE assays were performed on pooled samples of 2 brains at 30 C. The Ellman method (5) for AChE assay was employed; using a Beckman Model B spectrophotometer.

Results and Discussion

Exposure of control (non-pretreated) fish to 200 ppb parathion for 10 hr produced 63.5, 74.4 and 67.6% inhibition of AChE activity in brains of shiners, green sunfish and bluegills respectively (Table 1).

Fish pretreated for 24 hr in 2 ppm sesamex solution prior to exposure to 200 ppb parathion had depressed brain AChE activities of 45.9, 40.0 and 46.8% respectively for shiners, green sunfish and bluegills (Table 1). Sesamex pretreatment alone did not alter AChE activity.

The difference between control AChE activities (shiners 42.7±0.2, green sunfish 28.6±0.1 and bluegills 29.0±1.2) is probably a result of a smaller brain size rather than a naturally higher activity, as brain size influences observed activity (6, 7).

Conclusions

Our experiments indicate that the degree of brain AChE inhibition resulting from exposure to parathion is decreased by pretreatment with sesamex. Presumably the decrease is mediated as in other species - through inhibition of the activating enzyme.

TABLE 1

Mean brain AChE activity and % AChE inhibition in 3 species of fishes treated with 2 ppm sesamex and 200 ppb parathion or parathion alone.

Treatment	Species	Mean Activity[1]	% Inhibition
None	Shiners	42.7±0.2	-
	Greens	28.6±0.1	-
	Bluegills	29.0±1.2	-
Parathion	Shiners	15.6±4.3	63.5
	Greens	7.3±1.3	74.4
	Bluegills	9.4±1.3	67.6
Sesamex + Parathion	Shiners	23.1±3.9	45.9
	Greens	17.2±2.2	40.0
	Bluegills	15.4±1.4	46.8

[1] Micromoles of substrate hydrolyzed/min/g of tissue

Although this series of experiments did not include LC_{50} data, experiments with Gambusia indicate that pretreatment with 2 ppm sesamex effects at least a 10 fold increase in the 48-hr LC_{50} (8). Also, the normal rates of activation and subsequent inhibition of brain AChE may vary among species (7). Our data further substantiate the observation by Potter and O'Brien (3) that activation, presumably microsomal, is observed in aquatic as well as terrestrial species.

References

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